Electronic Version
Stylesheet Version v1.1.1

Description

[HEAT INSULATION PEDESTAL AND VERTICAL TYPE FURNACE TUBE]

BACKGROUND OF INVENTION

[0001] Field of the Invention

[0002] The present invention relates to a furnace structure. More particularly, the present invention relates to a heat insulation pedestal and a vertical type furnace tube.

[0003] Description of the Related Art

[0004] In the fabrication of semiconductor devices, many steps are often involved. In some of these steps, prolonged high-temperature treatment is frequently required in process such as thermal diffusion. At present, most thermal diffusion processes are commonly carried out using vertical type furnace tubes because a vertical furnace tube typically occupies very little space.

[0005] Fig. 1 is a cut away view showing the structure of a conventional vertical type furnace tube. As shown in Fig. 1,

the vertical furnace tube 100 mainly comprises an outer furnace tube 102, an inner furnace tube 104, a wafer boat 106, a heat insulation pedestal 108 and wafer boat holder 110. Before carrying out the processing, wafers 112 are placed inside the wafer boat 106 and then the wafer boat 106 is raised from the bottom section of the inner tube 104 into the interior of the inner tube 104. The pedestal 108 is located inside the inner tube 104 below the wafer boat 106. The wafer boat holder 110 is set up between the wafer boat 106 and the pedestal 108.

[0006] After performing a conventional high-temperature thermal treatment such as a well diffusion process inside a conventional vertical furnace tube, some of the wafers are broken as a result of abnormal transport. On close examination, the principal reason is found to be the deformation of the heat insulation pedestal. The cause of pedestal deformation is explained in more detail in the following with reference to Figs. 2A and 2B.

[0007] Figs. 2A and 2B are the perspective view and the side view of section II of the pedestal in Fig. 1. As shown in Fig. 2A and 2B, the heat insulation pedestal 108 comprises a top support 202, a plurality of heat insulation plates 204 and a number of connection sections 206. The top support

202 is used for supporting the wafer boat 106 and the wafer boat holder 110 (see Fig. 1). The heat insulation plates 204 are set up under the top support 202. The connection sections 206 connect various heat insulation plates 204 to the top support 202. The heat insulation pedestal 108 deforms mainly because the wafer boat 106, the wafer boat holder 110 and the wafers 112 (see Fig. 1) weigh down on the top support 202 during a lengthy high temperature processing operation. The deformation of the top support 202 often leads to a tilting of the wafer boat 106 and hence increasing the likelihood of wafer damage 112 during transportation.

[0008] To prevent damage to the wafer products, the heat insulation pedestal of the vertical type furnace tube in a production line must be replaced at fixed interval. However, replacing the pedestal not only costs a lot of money but also wastes a lot of processing time. Ultimately, productivity of the thermal processing operation is reduced.

SUMMARY OF INVENTION

[0009] Accordingly, at least one objective of the present invention is to provide a heat insulation pedestal that resist deformation at a high operating temperature.

[0010] At least a second objective of the present invention is to

provide a vertical type furnace tube capable of reducing production cost and increasing productivity.

[0011] To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the invention provides a heat insulation pedestal for a furnace. The heat insulation pedestal comprises a top support, a plurality of heat insulation plates and a number of connection sections. The top support has an annular base and a reinforced structure. The reinforced structure and the annular base are connected to provide the top support with an overall structural strength greater than the annular base. The heat insulation plates are set up below the top support. The connection sections connect various heat insulation plates and connect the top support to one of the heat insulation plates.

[0012] According to the heat insulation pedestal of this embodiment, the annular base and the reinforced structure are combined to form an integrative unit. In addition, the annular base and the reinforced structure can be combined to form a top support having a drum shape configuration or a cylinder shape configuration.

[0013] The present invention also provides a vertical type furnace

tube. The furnace tube comprises an outer tube, an inner tube, a wafer board and a heat insulation pedestal. The inner tube is located inside the outer tube. The wafer boat is set up inside the inner tube. The heat insulation pedestal is positioned inside the inner tube below the wafer boat. The heat insulation pedestal further comprises a top support for supporting the wafer boat, a plurality of heat insulation plates and a number of connection sections. The top support further comprises an annular base and a reinforced structure. The reinforced structure and the annular base are connected to provide the top support with an overall structural strength greater than the annular base. The heat insulation plates are set up below the top support. The connection sections connect various heat insulation plates and connect the top support to one of the heat insulation plates.

[0014] According to the vertical furnace tube of this embodiment, the annular base and the reinforced structure are combined to form an integrative unit. In addition, the annular base and the reinforced structure can be combined to form a top support having a drum shape configuration or a cylinder shape configuration.

[0015] In the present invention, a reinforced structure is incorpo-

rated to the annular base to form a drum shape or a cylinder shape top support having an enhanced structural strength. Thus, the heat insulation pedestal is more resistant to structural deformation than a conventional top support. Moreover, the structure can be fabricated through a modification of an existent top support structure using scrap material. Because the frequency of yearly pedestal replacement can be significantly reduced, productivity is increased and production time is shortened.

[0016] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF DRAWINGS

[0017] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[0018] Fig. 1 is a cut away view showing the structure of a conventional vertical type furnace tube.

[0019] Figs. 2A and 2B are the perspective view and the side view

of section II of the pedestal in Fig. 1.

[0020] Fig. 3 is a perspective view of a vertical type furnace tube according to one preferred embodiment of the present invention.

[0021] Fig. 4A is a perspective view of the pedestal in Fig. 3 according to a first embodiment of the present invention.

[0022] Fig. 4B is a perspective view of the pedestal in Fig. 3 according to a second embodiment of the present invention.

[0023] Fig. 5 is a cross-sectional view of the pedestal in Fig. 4B.

DETAILED DESCRIPTION

[0024] Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

[0025] Fig. 3 is a perspective view of a vertical type furnace tube according to one preferred embodiment of the present invention. As shown in Fig. 3, the vertical furnace tube 300 mainly comprises an outer furnace tube 302, an inner surface tube 304, a wafer boat 306, a heat insulation pedestal 308 and an optional wafer boat holder 310. The

wafer boat 306 and the wafer boat holder 310 are fabricated using silicon carbide (SiC), for example. The inner tube 304 is located inside the outer tube 302 and the heat insulation pedestal 308 is located under the wafer boat 306. The wafer boat holder 310 is set up between the wafer boat 306 and the heat insulation pedestal 308 for increasing the height level of the wafer boat 306. The inner tube 304 is fabricated using a refractory material including, for example, silicon carbide, silicon carbide coated graphite, graphite, quartz, silicon, ceramic, aluminum nitride, aluminum oxide, silicon nitride, magnesium oxide or chromium oxide.

[0026] Before carrying out some actual processing, wafers 112 are placed inside the wafer boat 306 using a transport device 312. With the pedestal 308 supporting the wafer boat 306 and the wafer boat holder 310, a elevating device 314 underneath the pedestal 308 is used to lift the wafer boat 306 from the bottom of the inner tube 304 into the interior of the inner tube 304. Thereafter, a shutter 316 outside the inner tube 304 seals off the inner tube 304. In general, the vertical furnace tube 300 also needs to include a heating element (not shown) surrounding the outer tube 302 to heat up the outer tube 302 and a ther-

mal couple inside the outer tube 302 for measuring surrounding temperature. Detail structure of the heat insulation pedestal 308 is shown in Figs. 4A, 4B and 5. Fig. 4A is a perspective view of the pedestal in Fig. 3 according to a first embodiment of the present invention. Fig. 4B is a perspective view of the pedestal in Fig. 3 according to a second embodiment of the present invention. Fig. 5 is a cross-sectional view of the pedestal in Fig. 4B.

[0027] As shown in Fig. 4A, the heat insulation pedestal 308a comprises a top support 410, a plurality of heat insulation plates 404 and a number of connection sections (not shown). The top support 410 further comprises an annular base 402 and a reinforced structure 408a. The reinforced structure 408a and the annular base 402 are joined together so that overall structural strength of the top support 410 is greater than the annular base 402. For example, the annular base 402 and the reinforced structure 408a of the heat insulation pedestal 308a form a drum shape top support 410. The annular base 402 and the reinforced structure 408a of the top support 410 are formed as an integrated unit. The heat insulation plates 404 are set up below the top support 410. In addition, the heat insulation plates 404, the top support 410 and the

connection sections are all fabricated using a material such as quartz.

[0028] The heat insulation pedestal 308b in Fig. 4B differs from the one in Fig. 4A mainly in the way the annular base 402 and the reinforced structure 408b are combined together. The annular base 402 and the reinforced structure 408b of the pedestal 308b are joined to form a cylinder shape top support 412 that produces an overall structural strength greater than the annular base 402. Although the configuration of the top support is illustrated using examples as shown in Figs. 4A and 4B, other types of modifications to the reinforced structure to produce the top support is permitted and hence should be included within the scope of the present invention.

[0029] Furthermore, the structure according to the present invention can be used for a prolonged period of time without causing any abnormal wafer transportation. As shown in Fig. 5, the heat insulation pedestal comprises a top support 412, a set of heat insulation plates 404 and a set of connection sections 406. The connection sections 406 connect various heat insulation plates 404 and the top support 412 to one of the heat insulation plate 404. Table 1 lists out the amount of deformation of the strengthened

pedestal according the present invention and a conventional pedestal after 14 months of continuous use. According to the table, the amount of deformation in the reinforced pedestal is only 0.116mm compared with the deformation in the conventional pedestal of about 1mm.

Table 1

Deformation comparison (units in mm)					
	Conventional Design			The design of the present invention	
	New Product	After 14 months		New Product	After 14 months
The lowest point	-0.017	-0.562	-0.6	-0.018	-0.053
The highest point	0.023	0.447	0.503	0.021	0.063
Amount of deformation	0.04	1.009	1.103	0.039	0.116

[0030] In summary, major aspect of the present invention includes:

[0031] 1. With a reinforced structure added to form a "drum shape" or a "cylinder shape" top support, the heat insulation pedestal is strengthened to reduce the amount of deformation and deformation-caused transport problems.

[0032] 2. Scrap material can be used to form the structural reinforcement to reduce overall production cost.

[0033] 3. Because the frequency of pedestal replacement is reduced when the top support is reinforced, overall productivity is increased while production time is reduced.

[0034] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.